Business Cycle Dynamics in Singapore: Key Drivers & Effectiveness of Monetary Policy

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Motivation

- Business cycles in a small open economy like S’pore are highly vulnerable to external shocks which accentuate the volatility caused by domestic factors.

- Indeed, the recent financial turmoil in industrial countries has resulted in international spillover effects to real economies.

- What are the key factors driving S’pore business cycles? How potent is monetary policy in Singapore as a counter-cyclical measure?
Description of our large panel data set: we use a large no. of macroeconomic variables, both local & foreign, to analyze S’pore business cycles.

Determine no. of underlying factors needed to summarize the information in the dataset and interpret them economically.

Assess the effectiveness of monetary policy as a counter-cyclical measure.
Large Panel Data Set
Large Panel Data Set

- $N = 177$ (136 local and 41 foreign economic series)
- $T = 60$ (sample period: 1993Q1 to 2007Q4)
- To avoid overweighting any one series, all series are transformed into standardized year-on-year growth rates.
Domestic Variables

Panel dataset provides a comprehensive coverage of all facets of domestic macroeconomic activity:

- GDP & its components (7)
- Gross value-added by sectors & sectoral indicators (43)
- Industrial production indices (7)
- Trade series (16)
- General price indices (14)
- Labour market variables (7)
- Monetary and financial series (25)
- Business expectations surveys (17)
Important to include foreign economic indicators that co-move with or lead domestic variables:

- Foreign GDP, CLI & asset prices of major trading partners (28)
- Global electronics series and composite electronics leading index (7)
- World prices and real foreign interest rates (6)
A key driver of the domestic business cycle is the global electronics cycle in view of Singapore’s heavy reliance on electronics exports.

We constructed the ELI in Chow and Choy (2006) for the purpose of forecasting global semiconductor sales.

The ELI components are: Nasdaq stock prices; US new orders of electronics; US ratio of electronics shipments to inventories; and US producer price index for DRAM

ELI has a proven lead of 3–6 months over world shipments of semiconductor products.
What are the underlying factors driving S’pore business cycles?
Factor Model Representation

The factor model is given by:

\[ X_{it} = L_i f_t + \varepsilon_{it}, \quad i = 1, \ldots, 17; \quad t = 1, \ldots, 56 \]

where \( X \) represent the variables; 
\( f \) is the \( (q \times 1) \) vector of common static factors; 
\( L \) represents the ‘factor loadings’; 
\( \varepsilon_t \) is the idiosyncratic disturbance.
Factor Model Estimation

- Each variable is decomposed into two unobservable components:
  - common cycles driven by a small number of factors.
  - an idiosyncratic term driven by variable-specific shocks.

- The underlying factors are linear combinations of variables which average out noisy disturbances in the idiosyncratic terms and capture the relevant information in the common cycles.

- The factor model is estimated using the technique of principal components analysis (PCA).
Based on a scree plot, we select 4 or 5 factors to represent the common cycles in our dataset.
### Number of Factors: Principal Component Analysis

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<th>No.</th>
<th>Eigenvalue</th>
<th>Proportion</th>
<th>Cumulative Proportion</th>
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<tr>
<td>10</td>
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</table>
Number of Factors: Total Variation Explained

- First four principal components together explain more than 50% of total variation in our economic series.

- A remarkable finding given large number and diversity of series employed.

- Each of the other principal components only explain at most 5% of total variation and are also less amenable to economic interpretation.
1st Rotated Factor Loadings

First Factor Loading
Interpretation of 1st Factor

- 1st rotated factor is linked to the *country-specific business cycle*.

- Places heavy weights on construction sector, property prices, real estate & bank lending; picks out domestic construction cycle and supporting services.

- Labour market variables and NEER/REER also score high, pointing unambiguously to domestic sources of fluctuations.
2nd Rotated Factor Loadings

Second Factor Loading

AIR
CAPTE
CONSTR
EMPHOTRES
EXPF
FORMFIN
GFCF
HKGDP
INDOGDP
LOAN
MFG
NONOIL
OFFSET
PIPP
PIPI
RUPI
TECH
ULC
WON
Interpretation of 2nd Factor

- 2nd rotated factor is linked to the *global business cycle*.
- Places heavy weights on external composite leading indexes and global price series.
- Reinforced by high ranks for Singapore’s export series.
3rd Rotated Factor Loadings

Third Factor Loading

-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
AIR
CAPTE
CONSTR
EMPHOTREST
EXPMFG
FORMFIN
GFCF
HKGDP
INDOGDP
LOAN
MFG
NONOIL
ORX
PPIOFF
RUPIAH
TECH
ULC
WON
Interpretation of 3rd Factor

- 3rd rotated factor is linked to the *global electronics cycle*.
- Places heavy weights on ELI and other electronic indicators.
- Local manufacturing output in top rankings as it is more strongly aligned to the electronics cycle than services production.
4th Rotated Factor Loadings

Fourth Factor Loading

AIR  CAPTE  CONSTR  EXPMFG  FORMFIN  GFCF  HKGDP  INDOGDP  LOAN  MFG  NONOIL  ORX  PPIOFF  RUPIAH  TECH  ULC  WON
4th rotated factor is linked to the *regional business cycle*.

Places heavy weights on regional stock prices, currencies and GDPs.

High loadings for sea cargo, wholesale and retail trade.

In line with regional orientation of Singapore’s exportable services.
Interpretation of Factors

- S’pore macroeconomic data can be approximated by a low-dimensional factor structure despite its diversity.

- Driving forces behind short-term fluctuations in S’pore macroeconomic variables are world, electronics, regional and domestic business cycles.

- Kose et al. (2003): aggregate co-movements in a broad cross-section of countries explained by worldwide, regional and country-specific business cycles.
How Potent is Monetary Policy as a Counter-Cyclical Measure?
To examine the effectiveness of monetary policy in Singapore, we use a FAVAR model to trace the monetary transmission mechanism.

For the sample period 1992Q1 to 2007Q4, we fit the FAVAR model to the following variables:

1. F1 (1st unrotated factor)
2. GDP growth rates (YOY)
3. CPI inflation rate (YOY)
4. TWI (log of NEER—the monetary policy instrument defined so that an increase is a depreciation).
Based on information criteria and diagnostic checks for white noise residuals, we choose 3 lags for the FAVAR model.

Apply recursive scheme with variables ordered as above to identify TWI innovations, thus implying that monetary policy reacts contemporaneously to information in F1, GDP and CPI but not vice versa.

Examine impulse response functions of variables to a TWI depreciation of 1.1%.
Impulse Response Function of GDP to a TWI shock

This will lead to a maximum of 0.7% increase in the GDP growth rate 2 quarters later.
The increase in the CPI inflation rate will be marginal at 0.1% also 2 quarters later.
Summary

- Our findings suggest four factors are sufficient to explain 57% of observed macroeconomic fluctuations in Singapore.

- Business cycle dynamics in Singapore are principally driven by global, electronics, regional and local cycles.

- The exchange rate (TWI) is an effective monetary policy instrument that can be used as a counter-cyclical measure to stimulate output in S’pore.
Thank You